INSTRUCTION MANUAL

FOR THE

DME/ATC TEST SET

TYPE 8925A

MP MASTER
MA25152

BOONTON DIVISION
Hewlett-Packard Company
Green Pond Road Rockaway, New Jersey
U. S. A.

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Hewlett-Packard Company
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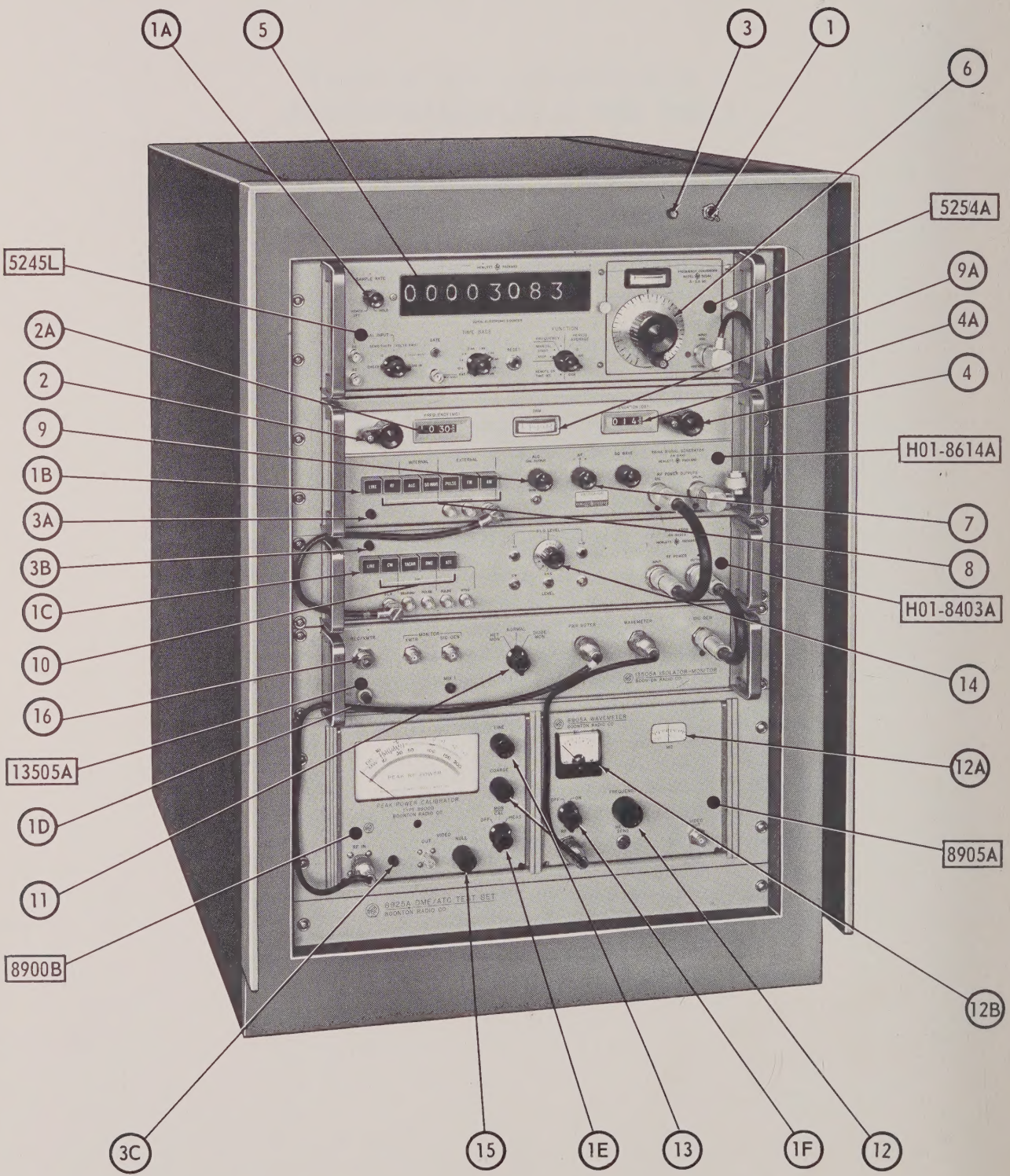


Figure 1. Front Panel — Instruments and Controls

SECTION I
DESCRIPTION

GENERAL

The Type 8925A DME/ATC Test Set is a system designed for testing and calibration of DME (Distance Measuring Equipment) and ATC Air Traffic Control) Transponder aircraft equipment. The system is self contained in a rack cabinet complete with forced-air cooling.

The Test Set consists essentially of six instruments; an -hp- HO1-8614A continuously tuneable Signal Generator; an -hp- 5245L Electronic Counter with an -hp- 5254A Frequency Converter for monitoring the Signal Generator output frequency; an -hp- HO1-8403A solid-state Modulator for modulating the output of the Signal Generator; a BRC Type 8900B Peak Power Calibrator; a BRC 8905A Wavemeter; and a BRC 13505A Isolator-Monitor which provides the various interconnections and monitoring facilities.

Each instrument of the Test Set is an individual identity having its own power switch, power supplies, and fusing. The system has a master switch circuit breaker and an indicator to denote power to the Test Set.

PANEL LAYOUT AND CONTROLS

A front view of the Test Set, with the separate instruments and controls indicated, is shown in Fig. 1. Only the basic controls used during DME and ATC testing procedures have numerical designations. The other controls and connectors are identified in the individual instruction manual for each specific instrument. Front panel designations are shown under Controls and Indicators within quotation marks.

Instruments

-hp- 5245L Electronic Counter with basic range of 0-50 mc.

-hp- 5254A Frequency Converter to extend the range of the Electronic Counter to 0.3 to 3.0 Gc.

-hp- HO1-8614A Signal Generator covering the range of 950 to 1250 mc.

-hp- HO1-8403A Modulator.

BRC Type 8900B Peak Power Calibrator with a standard calibrated range of 100 to 2000 watts at frequencies of 960 to 1215 mc.

BRC Type 8905A Wavemeter with a frequency range of 1070 to 1110 mc.

BRC Type 13505A Isolator-Monitor.

Controls and Indicators

1. Power Switch

This power switch circuit breaker controls the power to the complete Test Set. Power to the instruments is individually controlled on each instrument.

1A. Power Switch "SAMPLE RATE"

This rotary power switch on the Electronic Counter SAMPLE RATE control applies power to the Counter when rotated clockwise.

1B. Power Switch "LINE"

This pushbutton switch applies power to the Signal Generator when depressed. Depress slightly to release button for off.

1C. Power Switch "LINE"

This pushbutton switch applies power to the Modulator when depressed. Depress slightly to release button for off.

1D. Power Switch "LINE"

This combination power switch and indicator applies power to the Isolator-Monitor when depressed. Depress the button completely a second time for off.

1E. Function Switch "OFF—MON/ CAL-MEAS"

This rotary Function Switch applies power to the Peak Power Calibrator when in the MON/CAL and MEAS positions.

1F. Power Switch "OFF-ON"

This rotary switch applies power to the Wavemeter when in the ON position.

2. Frequency Control

The crank-type Frequency Control adjusts the frequency of the Signal Generator output.

2A. Frequency Indicator "FREQUENCY (MC)"

The digital readout Frequency Indicator is operated by the Frequency control (2).

3. Indicator Light

This Indicator Light shows power "on" to the Test Set.

3A. Indicator Light

This Indicator Light shows power "on" to the Signal Generator.

3B. Indicator Light

This Indicator Light shows power "on" to the Modulator.

3C. Indicator Light

This Indicator Light shows power "on" to the Peak Power Calibrator.

4. Attenuator Control

The crank-type Attenuator Control adjusts the output level of the Signal Generator.

4A. Attenuator Indicator "ATTENUATION (DB)"

The digital readout Attenuator Indicator is operated by the Attenuator Control (4).

5. Digital Readout.

This Digital Readout shows the output frequency of the Signal Generator on the Electronic Counter.

6. Mixing Frequency Selector

The Mixing Frequency Selector controls the frequency of the Converter used with the Electronic Counter to extend the range up to 3.0 Gc.

7. △F Control "△F"

The △F Control is used to change the Signal Generator output frequency in small increments for fine adjustment.

8. Pushbutton Switches—Signal Generator.

8A. "RF"—Turns on RF output.

8B. "ALC"—Activates automatic leveling of RF signal output.

8C. "SQ WAVE"—Not normally used for DME/ATC testing.

8D. "PULSE"—Not normally used for DME/ATC testing.

8E. "FM"—Not normally used for DME/ATC testing.

8F. "AM"—Used in conjunction with the Side Lobe Suppression facility of the ATC modulator.

9. Automatic Leveling Control "ALC—CAL OUTPUT"

The Automatic Leveling Control is used to standardize the RF output of the Signal Generator by adjusting the desired reference on the "DBM" meter with the control.

9A. Automatic Leveling Control Meter "DBM"

The Automatic Leveling Control Meter monitors the RF output of the Signal Generator.

10. Push-button Switches—Modulator.

10A. "CW"—Allows RF output to pass through the modulator without being modulated.

10B. "TACAN"—Connects DME video signal and simulated bearing information to Modulator.

10C. "DME"—Connects DME video signal to Modulator.

10D. "ATC"—Connects ATC video signal to Modulator.

11. Function Switch—Isolator-Monitor "HET MON—NORMAL—DIODE MON"

This Function Switch provides for viewing the output of the Modulator on an oscilloscope connected to the "MONITOR—SIG GEN" connector on the Isolator-Monitor. In the "HET MON" position the signal on the oscilloscope is the result of heterodyning the Modulator output with a local oscillator. In the "DIODE MON" position the signal on the oscilloscope is the diode detected output of the Modulator.

12. Frequency Control—Wavemeter "FREQUENCY"

The Frequency Control adjusts the tuned cavity resonator of the Wavemeter.

12A. Frequency Dial—Wavemeter "MC"

The Frequency Dial indicates the frequency to which the Wavemeter internal cavity resonator is tuned.

12B. Indicator Meter—Wavemeter

The meter is the resonance peak indicator when tuning the Wavemeter.

13. Coarse and Fine Controls—Peak Power Calibrator—"COARSE" "FINE"

These controls provide a means for adjusting the dc reference voltage, as monitored by the Peak RF Power Meter, to the peak of the detected RF pulse, while observing the waveform on an oscilloscope.

14. Side Lobe Suppression Control —Modulator "SLS LEVEL"

The Side Lobe Suppression Control adjusts the amplitude of the second pulse in the ATC mode relative to the first pulse. The control knob is calibrated in DB from +1 to −10 DB.

15. Video Null Control—Peak Power Calibrator—"VIDEO —NULL"

With the Function Switch in the MON/CAL position and no RF signal applied, the VIDEO NULL control is used to balance out the diode operating bias from the video waveform.

CONNECTORS[1]

16. Receiver Transmitter Connector —Isolator-Monitor— "REC/XMTR"

The REC/XMTR connector is used to connect DME and ATC equipment to the Test Set for testing and calibration.

[1]There is only one connector indicated in Fig. 1. The balance of the connectors will be shown in Operating Instructions — Section III.

SECTION II
SPECIFICATIONS

Radio Frequency Characteristics

RF RANGE: 950-1250 mc

RF ACCURACY: Determined by ability to set to desired reading on counter

RF SETTABILITY

Main Drive: Better than 100 kc
Vernier △f: Better than 50 kc

RF STABILITY

Temperature: <0.005% per degree C
Line Voltage: <0.003% (±10% line voltage change)

RF OUTPUT

Range: —10 to —120 dbm across external 50-ohm load at output jack

Accuracy:

ATTENUATOR SETTING	ATC (1015-1045 mc)	DME (960-1250 mc)
—10 to —14 dbm	±0.85 db	±1.25 db
—14 dbm	±0.6 db	±1.0 db
—14 to —100 dbm	±(0.75 +0.07 per 10db)db	±(1.15 +0.07 per 10db)db
Leveled Output: (fixed atten. position)	±0.2 db	±0.6 db

Impedance: 50 ohms

VSWR: <1.35:1

Pulse Modulation Characteristics

PM SOURCE

Simulation of DME/ATC ground emission as provided by Collins 578X-1 and 578D-1 Test Sets

	ATC	DME
PM RISE TIME	>50 ns and <100 ns	Controlled by pulse source to meet "Pulse Shape" Spec., Sect. G, Appendix A, RTCA 167-59/DO-99
PM FALL TIME	>50ns and <200 ns	Controlled by pulse source to meet "Pulse Shape" Spec., Sect. G, Appendix A, RTCA 167-59/DO-99
PM OVERSHOOT	<5%	not meaningful

SIDE LOBE SUPPRESSION

The second pulse of a train of 2 (or 3) pulses may be varied +1 to —10 db from the first pulse when its leading edge is ≧2 μsec from the first pulse leading edge. (See RTCA 181-61/DO-112, Appendix A, T-6, Steps 1, 2, 3, 4, 9, 10.)

SIMULATED BEARING INPUT

Audio Frequency input to BNC jack under TACAN button will simulate bearing modulation to a depth of 55% max. (3.8 db above pulse tips).

Power Measurement Characteristics

RF RANGE: 960-1215 mc.

RF POWER RANGE:

100-2000 watts peak (the range is determined by a fixed attenuator. Other ranges are available on special order.)

RF POWER ACCURACY:

±1.2 db (with special calibration, ±0.6 db)

Frequency Measurement Characteristics

RF RANGE: 1070-1110 mc

RF ACCURACY: ±0.5 mc for input peak powers 250 watts to 1000 watts

Monitor Characteristics

Signal Generator Monitor (MONITOR—SIG GEN)

HETERODYNE MONITOR (HET MON)

Frequency Range: 1018 — 1033 mc (for beating oscillator 1025 ± 1 mc)
Output Level: 0.5 volts peak at —10 dbm rf level (IF center)
Load Impedance: 150 ohms nominal
Bandwidth: 9 mc nominal (equivalent low pass bandwidth 4 mc)
Linearity: ±0.5 db (—10 to —20 dbm rf level)

DIODE MONITOR (DIODE MON)

Frequency Range: 950-1250 mc
Output Level: 0.1 volts peak at —10 dbm rf level
Low Pass Bandwidth: 5 mc

TRANSMITTER MONITOR (MONITOR-XMTR)

Output Level: Approx. 0.2 volts peak for 200 watt peak input into specified load impedance

Load Impedance: 150 ohms nominal
Bandwidth: 10 mc nominal
Linearity: ±1 db for 200 to 2000 watts peak input

Transmitter Interlock: Terminals are provided for de-energizing the transmitter when the system internal load is removed from the transmitter antenna.

Instrument Complement

-hp- HO1-8614A	Signal Generator
-hp- HO1-8403A	Modulator
-hp- 5245L	Electronic Counter
-hp- 5254B	Frequency Converter
BRC Type 13505A	Isolator-Monitor
BRC Type 8900B	Peak Power Calibrator
BRC Type 8905A	Wavemeter

Accessories Available

-hp- 175A Oscilloscope
Collins 578D-1 DME Bench Test Set
Collins 578X-1 ATC Transponder Test Set

Physical Characteristics

MOUNTING: Enclosed rack mounting complete with forced-air cooling.

FINISH: Gray (Other finishes available on special order).

DIMENSIONS: (see Fig. 2)

WEIGHT: 285 Lbs. (129.3 kg)

Power Requirements: 105-125 or 210-250 volts, 50-60 cps, 400 watts. A master circuit breaker/switch controls power to the complete rack.

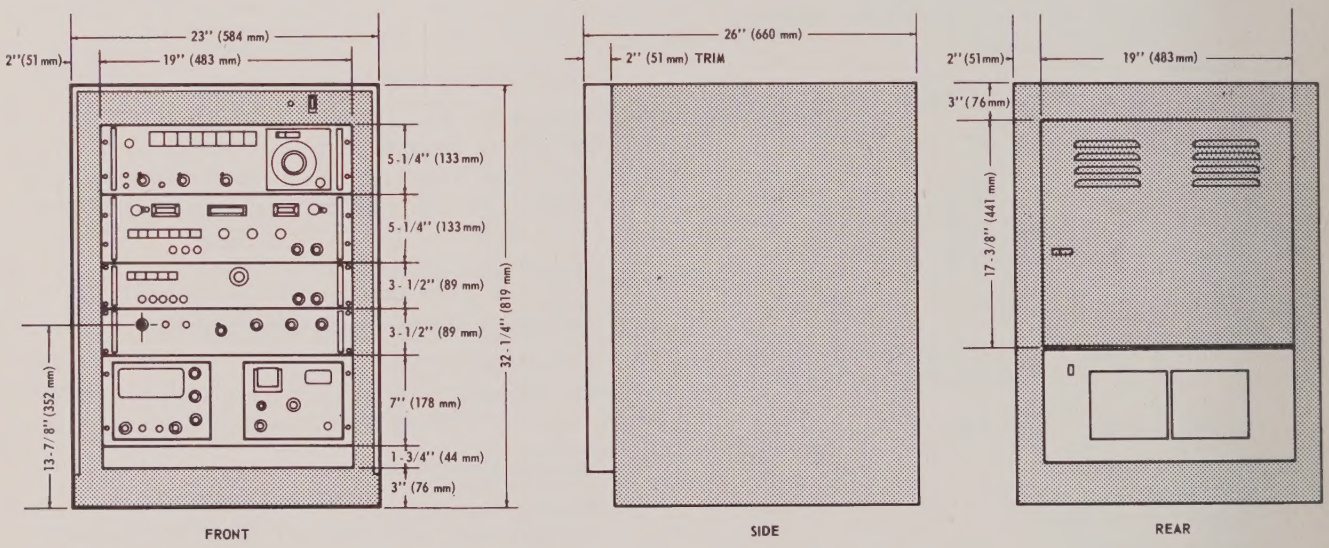


Figure 2. 8925A — Dimensions

SECTION III
OPERATING INSTRUCTIONS

INSTALLATION

Remove the Type 8925A DME/ATC Test Set from its shipping container and set it up in the test area where it is to be used. Cables to be used with the Test Set should be removed from their packaging. The following chart shows the cable color code, cable location, and purpose.

The cables numbered 1, 2, 4, 5, 6 and 7 are interconnecting cables for instruments of the 8925A Test Set. Cable number 3 is for connecting the 8925A to the DME or ATC equipment under test. Cables 8 through 12 are identical, six-foot, video cables for use in connecting the Test Set to external equipment; i.e., an oscilloscope or modulators. The block diagram of Fig. 3 shows the location of the cables. Connect cables 1, 2, 4, 5, 6 and 7 as shown.

Color Code	Location		Type Signal
	From	To	
1. Brown	Sig. Generator (RF OUTPUT-CAL)	Modulator (INPUT)	RF
2. Red	Modulator (OUTPUT)	Isolator-Monitor (SIG GEN)	RF
3. Purple	Isolator-Monitor (REC/XMTR)	DME/ATC equipment under test	RF
4. Yellow	Isolator-Monitor (PWR METER)	Peak Power Calibrator (RF IN)	RF
5. Green	Isolator-Monitor (WAVEMETER)	Wavemeter (RF IN)	RF
6. Blue	Signal Generator (RF OUTPUT-UNCAL)	Electronic Counter (INPUT)	RF
7. Orange	Modulator (SLS)	Signal Generator (AM)	Video
8. Gray 9. Maroon 10. Pink 11. White 12. Tan	Test Set	External Equipment	Video

The Test Set, as shipped from the factory, is normally connected for 105 to 125v, 50 to 60 cps operation. The six individual instruments and the blower system of the 8925A can be converted for 210 to 250v operation by operating the input voltage switches and changing the fuses on the rear panel of each instrument. An input voltage switch at the rear of the 8925A cabinet converts the blower system only for 115 or 230v operation. This switch is not associated with a fuse other than protection supplied by the circuit breaker.

Turn on the Power Switch (1). The Indicator (3) should be lighted. Check power switches (1A, 1B, 1C, 1D, 1E, and 1F) to assure all instruments are operating. Allow Test Set to warm up a minimum of 2 hours before making preliminary settings and tests.

INSTRUMENT CHECKOUT

The following procedure is for the purpose of assuring proper operation of the DME/ATC Test Set before using it for testing.

Equipment Required

1. DME Modulator (such as the Collins 578D-1 DME Bench Test Set modified for Gaussian DME pulse output).
2. ATC Modulator (such as the Collins 578X-1 Transponder Test Set).
3. -hp- 175A Oscilloscope with -hp-1750A dual trace plug-in head or equivalent.
4. -hp- 431B Power Meter with -hp-478A Thermistor Mount or equivalent.
5. -hp- 200 series Audio Oscillator or equivalent.

   Must have 10 volt peak output at 135 cps.
6. 150-ohm termination.

Checkout

In the following procedure all of the bold type words or designations

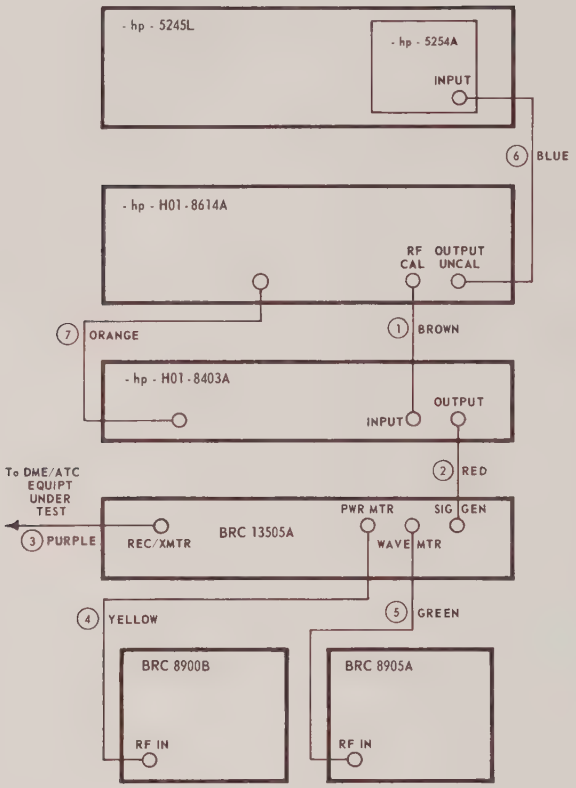


Figure 3. 8925A — Interconnecting Cables Locations

are controls or connectors on the 8925A Test Set.

1. Connect equipment as follows:

a. DME modulator video output to **PULSE-DME** (HO1-8403A) Video output signal to be 10 ± 0.5v peak.

b. DME modulator sync signal to oscilloscope.

c. Oscilloscope (one channel) to **MONITOR - SIG GEN** (13505A).

(The oscilloscope must be connected using 62/U cable and 150-ohm termination).

For comparison purposes, the second channel of the oscilloscope can be connected to the DME modulator at the same point as in step 1a.

2. Turn on all equipment and allow two hours for warmup.

3. Depress **RF** and **ALC** pushbuttons on the Signal Generator (HO1-8614A).

4. Adjust **ALC - CAL OUTPUT** control (HO1-8614A) for 0 dbm reading on DBM Meter.

5. Rotate the **Frequency** control (HO1-8614A) over the entire range of the instrument. The meter should hold the 0 dbm setting.

6. As read on the Electronic Counter (5245L/5254A), the Signal Generator output (HO1-8614A) should cover the frequency range of 950 to 1250 mc.

7. Connect the Power Meter to **REC/XMTR** (13505A).

8. Adjust the **Attenuator Control** (HO1-8614A) for a reading of approximately −14 dbm on the Power Meter.

9. Rotate the **Frequency** control (HO1-8614A) over the entire range of the instrument. The output, as read on the Power Meter, should be −14 ± 1 dbm.

10. Adjust the Signal Generator (HO1-8614A) frequency for 1030 mc and the Attenuator Control for +10 dbm.

11. Rotate the **Monitor Selector Switch** (13505A) to the **HET MON** position. The CW level should be 1 v p-p minimum.

12. Depress the **DME** pushbutton on the Modulator (HO1-8403A).

13. The oscilloscope display should be as shown in Fig. 4A.

14. Rotate the **Monitor Selector Switch** (13505A) to the **DIODE MON** position. The oscilloscope display should be as shown in Fig. 4B.

15. Rotate the **Monitor Selector Switch** (13505A) to the **HET MON** position. (Fig. 4A shows oscilloscope displays.) At this point the waveforms of the output of the DME Modulator and the modulated RF output of the 8925A can be compared as in Fig. 4C.

16. Connect the audio oscillator to **BEARING** (HO1-8403A). Adjust the audio oscillator for 135 cps with the attenuator set at minimum.

17. Depress the **TACAN** pushbutton on the Modulator (HO1-8403A). The oscilloscope display should remain as in Fig. 4A.

18. Increase the output of the audio oscillator. The DME pulses can be modulated to approximately 55% as shown in Fig. 4D.

19. Disconnect the DME Modulator and the audio oscillator from the setup.

20. Connect the ATC Modulator to **PULSE - ATC** and **SYNC** (HO1-8403A). Make appropriate connections to the oscilloscope.

21. Depress the **ATC** (HO1-8403A) and the **AM** (HO1-8614A) pushbuttons. Adjust the Signal Generator frequency for 1030 mc. The **Monitor Selector Switch** (13505A) should be in the **HET MON** position. The oscilloscope display should be as shown in Fig. 4E.

Figure 4. Oscilloscope Display—DME and ATC Pulse Shapes

22. Rotate the **SLS** (HO1-8403A) control. The second pulse amplitude should vary over an 11 db range with respect to the first pulse (+1 to −10 db).

23. Disconnect power meter at **REC/XMTR** (13505A). Disconnect cable to **PWR METER** (13505A) and connect it to **REC/XMTR** (13505A). This will allow the maximum output from the Signal Generator to be used for testing the Peak Power Calibrator.

24. Connect one channel of the oscilloscope to **VIDEO OUT** (8900B). Increase the Signal Generator output to maximum.

25. The Peak Power Calibrator should indicate peak power in the range below −10 db.

NOTE: The object of this procedure is not to make measurements, but to check operation of the various instruments, so the peak power indicated is of no consequence.

26. Disconnect the cable to **REC/XMTR** (13505A) and return it to its original place at **PWR METER** (13505A).

27. Disconnect cable to **WAVEMETER** (13505A) and connect it to **REC/XMTR** (13505A). Change oscilloscope connection from **VIDEO OUT** (8900B) to **VIDEO OUT** (8905A).

28. Adjust Signal Generator for maximum output at 1090 mc (monitored by the Electronic Counter).

29. Adjust **FREQUENCY** (8905A) control for indication on the oscilloscope. Maximum indication should occur at 1090 ± 0.5 mc as read on the **Frequency Dial** (8905A).

30. Disconnect the cable to **REC/XMTR** (13505A) and return it to its original place at **WAVEMETER** (13505A).

NOTE: If any discrepancies are indicated during the checkout procedure they should be noted and the individual instruction manuals for each instrument involved should be used to determine the reason for the discrepancy.

USING THE TEST SET

Auxiliary Equipment Required

The following equipment is recommended for use with the 8925A Test Set for complete testing and calibration of DME and ATC aircraft equipment. Pertinent information is given for substitution purposes.

1. -hp- 175A Oscilloscope with 1750A Dual Trace Vertical Amplifier
   - Sensitivity: 50 mv/cm (each channel)
   - Bandwidth: 40 mc (each channel)
   - Sweep Speed: 0.1 μsec/cm to 5 sec/cm
2. -hp- 410B VTVM
3. Collins 578D-1 DME Bench Test Set (Modified for Gaussian DME pulse output)
4. Collins 578X-1 ATC Transponder Test Set

Measurement Procedures

The following procedures for testing DME and ATC equipment are typical setups. Reference should be made to the instruction manual concerning the particular DME or ATC equipment under test for additional information. Any data listed herein will conform to the ARINC Characteristic No. 521D (DME) and the ARINC Characteristic No. 532D (ATC) specifications.

For more detail when operating the 8925A Test Set, refer to the specific instruction manual for the test instrument involved.

For these procedures the following titles will be used in reference to the equipment:

Title	Equipment
8925A	BRC Type 8925A Test Set as a complete unit
Sig. Gen.	-hp- HO1-8614A Signal Generator
Modulator	-hp- HO1-8403A Modulator
Counter	-hp- 5245L Electronic Counter with an -hp- 5254A Frequency Converter
Isolator-Mon	BRC Type 13505A Isolator-Monitor
Peak Pwr Calib	BRC Type 8900B Peak Power Calibrator
Wavemeter	BRC Type 8905A Wavemeter
Modulator (DME)	Collins 578D-1 DME Bench Test Set
Modulator (ATC)	Collins 578X-1 Transponder Test Set
Oscilloscope	-hp- 175A Oscilloscope
DME	DME radio under test
ATC	ATC radio under test

DME EQUIPMENT TESTING

Initial Setup

1. Connect the 8925A, the Modulator (DME), the Oscilloscope, and the DME as shown in the block diagram, Fig. 5.

2. Set up Sig. Gen. frequency.
   a. Depress RF pushbutton (8A).
   b. Referring to Table 1 for receiver frequencies, adjust the Sig. Gen. to Channel 30 as shown on digital readout (2A).
   c. Adjust Mixing Frequency Selector (6) until meter above the control reads maximum at a frequency just below the frequency indicated on the digital readout (5).
   d. Adjust Frequency (2) and △F (7) controls for the correct frequency as read on the digital readout (5).

At this point the Sig. Gen. frequency may be changed by ± 50 mc without changing the setting of the counter. See the -hp- 5245L and -hp- 5254A instruction manuals for details.

3. Set up the Modulator (DME) as follows:
   a. Set channel selectors to *Channel 30.*

NOTE: Always set Modulator (DME) channel selectors to the same channel as the 8925A.

   b. Set reply efficiency to *NORMAL.*
   c. Set pulse spacing — μsec to *12.*
   d. Set distance — mi to *72.*
   e. Set squitter rate to *2700.*
   f. Set speed to *mid-range.*
   g. Set sync selector to *INTERR.*
   h. Set DME (Off-Stby-On) to *STBY.*
   i. Set DME (Search Limit) to *NORMAL.*

4. Set 8925A controls as follows:
   a. Turn attenuator control (4) to minimum.
   b. Depress ALC pushbutton (8B).
   c. Adjust ALC control (9) for "O" (approximately mid-scale) on DBM Meter (9A).
   d. Depress CW pushbutton (10A).

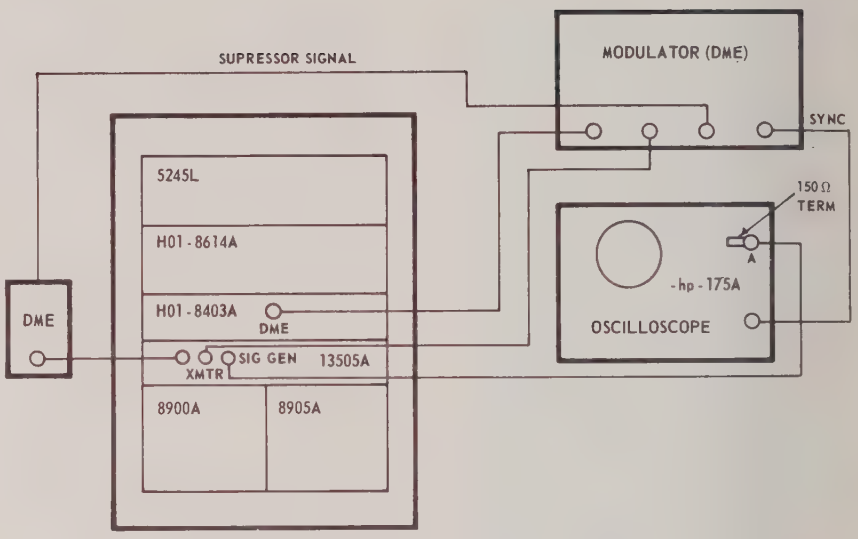


Figure 5. Setup for DME Equipment Testing

NOTE: When DME pulsed signal is required for a test procedure, the DME pushbutton (10C) must be depressed.

CAUTION: When operating the HO1-8403A Modulator in the DME or ATC mode, the modulator should only be switched to CW for brief periods *when required.* In the event that the modulator is kept in the CW mode for several minutes, a short time will be required for the pulses to return to the calibrated level. (See Section V — Operational Guide — Drift Data).

   e. Set Function Switch (11) to NORMAL.

Transmitter Power

1. Use the Initial Setup for DME except the oscilloscope should be connected to the VIDEO OUT connector on the Peak Pwr Calib.

2. Set the Function Switch (1E) to the MON/CAL position. With the oscilloscope set to "free run", adjust the VIDEO NULL control (15) until the two horizontal lines, observed on the oscilloscope, are superimposed as in Fig. 6.

This operation balances out the detector diode bias from the video waveform which otherwise might be read as RF power.

NOTE: The VIDEO NULL control need not be adjusted for repetitive measurements.

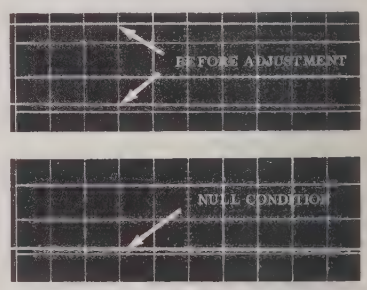


Figure 6. Oscilloscope Display — Null Adjustment

3. On the Modulator (DME), set the DME (Off-Stby-On) switch to the ON position.

4. Set the Function Switch (1E) to the MEAS position.

5. Using the COARSE and FINE controls (13), adjust the dc reference voltage until the adjustable horizontal line coincides with the peak of the

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VOR/ILS/VHF	
1	962	1025	134.4	
2	963	1026	134.5	
3	964	1027	134.6	
4	965	1028	134.7	
5	966	1029	134.8	
6	967	1030	134.9	
7	968	1031	135.0	
8	969	1032	135.1	
9	970	1033	135.2	
10	971	1034	135.3	
11	972	1035	135.4	
12	973	1036	135.5	
13	974	1037	135.6	
14	975	1038	135.7	
15	976	1039	135.8	
16	977	1040	135.9	
17	978	1041	108.0	
18	979	1042	108.1	
19	980	1043	108.2	
20	981	1044	108.3	
21	982	1045	108.4	
22	983	1046	108.5	
23	984	1047	108.6	
24	985	1048	108.7	
25	986	1049	108.8	
26	987	1050	108.9	
27	988	1051	109.0	
28	989	1052	109.1	
29	990	1053	109.2	
30	991	1054	109.3	
31	992	1055	109.4	
32	993	1056	109.5	
33	994	1057	109.6	
34	995	1058	109.7	
35	996	1059	109.8	
36	997	1060	109.9	
37	998	1061	110.0	
38	999	1062	110.1	
39	1000	1063	110.2	
40	1001	1064	110.3	
41	1002	1065	110.4	
42	1003	1066	110.5	
43	1004	1067	110.6	
44	1005	1068	110.7	
45	1006	1069	110.8	
46	1007	1070	110.9	
47	1008	1071	111.0	
48	1009	1072	111.1	
49	1010	1073	111.2	
50	1011	1074	111.3	
51	1012	1075	111.4	
52	1013	1076	111.5	
53	1014	1077	111.6	
54	1015	1078	111.7	
55	1016	1079	111.8	
56	1017	1080	111.9	
57	1018	1081	112.0	
58	1019	1082	112.1	
59	1020	1083	112.2	
60	1021	1084	133.3	
61	1022	1085	133.4	
62	1023	1086	133.5	
63	1024	1087	133.6	
64	1151	1088	133.7	
65	1152	1089	133.8	
66	1153	1090	133.9	
67	1154	1091	134.0	
68	1155	1092	134.1	
69	1156	1093	134.2	
70	1157	1094	112.3	
71	1158	1095	112.4	
72	1159	1096	112.5	
73	1160	1097	112.6	
74	1161	1098	112.7	
75	1162	1099	112.8	
76	1163	1100	112.9	
77	1164	1101	113.0	
78	1165	1102	113.1	
79	1166	1103	113.2	
80	1167	1104	113.3	
81	1168	1105	113.4	
82	1169	1106	113.5	
83	1170	1107	113.6	
84	1171	1108	113.7	
85	1172	1109	113.8	
86	1173	1110	113.9	
87	1174	1111	114.0	
88	1175	1112	114.1	
89	1176	1113	114.2	
90	1177	1114	114.3	
91	1178	1115	114.4	
92	1179	1116	114.5	
93	1180	1117	114.6	
94	1181	1118	114.7	
95	1182	1119	114.8	
96	1183	1120	114.9	
97	1184	1121	115.0	
98	1185	1122	115.1	
99	1186	1123	115.2	
100	1187	1124	115.3	
101	1188	1125	115.4	
102	1189	1126	115.5	
103	1190	1127	115.6	
104	1191	1128	115.7	
105	1192	1129	115.8	
106	1193	1130	115.9	
107	1194	1131	116.0	
108	1195	1132	116.1	
109	1196	1133	116.2	
110	1197	1134	116.3	
111	1198	1135	116.4	
112	1199	1136	116.5	
113	1200	1137	116.6	
114	1201	1138	116.7	
115	1202	1139	116.8	
116	1203	1140	116.9	
117	1204	1141	117.0	
118	1205	1142	117.1	
119	1206	1143	117.2	
120	1207	1144	117.3	
121	1208	1145	117.4	
122	1209	1146	117.5	
123	1210	1147	117.6	
124	1211	1148	117.7	
125	1212	1149	117.8	
126	1213	1150	117.9	

Short Range Limited Range

TABLE 1. Tacan Channel Selection Frequencies

pulse displayed on the oscilloscope as in Fig. 7.

6. Read the peak power on the front panel meter of the Peak Pwr Calib. As calibrated for a standard 8925A, the MW scale will read nominally 100 to 2000 watts.

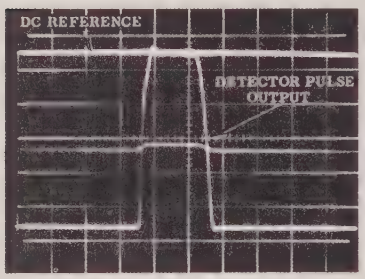


Figure 7. Oscilloscope Display — Pulse Measurement

Interrogator Pulse Characteristics

As specified in the ARINC No. 521D, the DME Interrogator Pulses shall have the following characteristics:

1. The pulse rise time from 10% to 90% of maximum voltage amplitude shall be 2.5 ± 0.5 μsec.

2. The pulse fall time from 90% to 10% of maximum voltage amplitude shall be 2.5 ± 1.0 μsec.

3. The pulse duration, measured at 50% (6db) of maximum voltage amplitude, shall be 3.5 ± 0.5 μsec.

4. The pulse repetition rate in "search" condition shall not exceed 150 pulse pairs per second. In "tracking" condition the pulse repetition rate shall not exceed 30 pulse pairs per second.

5. The pulses shall be coded in pairs with a spacing of 12 ± 0.5 μsec. from the leading edge of the first pulse to the leading edge of the second pulse at 50% (6db) of the maximum voltage amplitude.

6. The instantaneous amplitude of the pulses shall not fall below 95% of maximum voltage amplitude between 95% of the maximum voltage amplitude of the leading edge and 95% of the maximum voltage amplitude of the trailing edge of the pulse.

Observing the DME Interrogator (Airborne Transmitter) Pulses

1. Use the Initial Setup for the DME except the oscilloscope should be connected to the MONITOR-XMTR connector on the Isolator-Mon with 150-ohm load at oscilloscope end of the cable.

2. The Function Switch (1E) should be in the MON/CAL position.

NOTE: A diode detector as used for monitoring is a nonlinear device resulting in amplitude distortion. For exacting amplitude measurements the oscilloscope grid must be calibrated with the particular diode used and at the particular operating levels.

3. Observe the following pulse characteristics:

a. Pulse rise time
b. Pulse fall time
c. Pulse duration
d. Pulse repetition rate

NOTE: With sufficient output from the MONITOR-XMTR, the pulse repetition rate can be measured with the 5245L Electronic Counter. See Section V — Operational Guide, Counting DME/ATC Video Pulses etc.

e. Pulse coding
f. Pulse top

These characteristics should conform to the requirements specified in the DME equipment handbook.

ATC EQUIPMENT TESTING

Initial Setup

1. Connect the 8925A, the modulator (ATC), the oscilloscope, and the ATC as shown in Fig. 8.

2. Set up Sig. Gen. frequency.

a. Depress RF pushbutton (8A).
b. Adjust Sig. Gen. to 1030 mc as shown on digital readout (2A).
c. Adjust Mixing Frequency Selector until the meter above the control reads maximum at a frequency just below the frequency indicated on the digital readout (2A).
d. Adjust Frequency (2) and △F (7) controls for the correct frequency as read on digi tal readout (5).

At this point the Sig. Gen. frequency may be changed by ±50 mc without changing the setting of the counter. See the -hp- 5245L and -hp- 5254A instruction manuals for details.

3. Set up the modulator (ATC) as follows:

a. Set the interrogation mode and transponder mode to *A*.

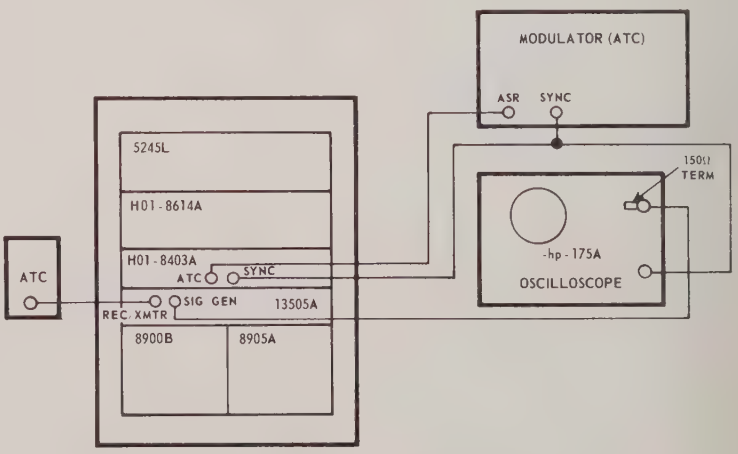


Figure 8. Setup for ATC Equipment Testing

b. Set 2nd int delay-μsec to *OFF*.
c. Set interrogation spacing-μsec to *0*.
d. Set interrogation rate control to *90*.
e. Set interrogation rate multiplier to *X10*.
f. Set No. 2 int pulse to *ON*.
g. Set sync to *FIXED*.
h. Set side lobe suppressor to *OFF*.
i. Set marker spacing-μsec to *1.0*.
j. Set transponder reply code selector to desired code. (See Table 2.)
k. Set transponder ident to center.
l. Set transponder disable to down position.
m. Balance of controls are not critical except during actual test procedures.

4. Set the 8925A controls as follows:
   a. Turn attenuator control (4) to minimum.
   b. Depress ALC pushbutton (8B).
   c. Adjust ALC control (9) for "0" (approximately mid-scale) on DBM Meter (9A).
   d. Depress CW pushbutton (10A).

NOTE: When ATC pulsed signal is required for a test procedure, the ATC pushbutton (10D) must be depressed.

   e. Set Function Switch (11) to Normal.

Transmitter Power

The ATC transmitter normally operates only after being interrogated by the ground station (or simulated ground station). This signal must be supplied to the ATC receiver during transmitter power testing. The ATC pushbutton (10D) must be depressed for this test.

For this procedure refer to Transmitter Power (DME).

Transmitter Pulse Characteristics

As specified in the ARINC Characteristic 532C, the ATC transmitter pulses shall have the following characteristics:

A B C D E F G H					
Code No.	Information Pulses Present	Code No.	Information Pulses Present	Code No.	Information Pulses Present
00	NONE	30	BC	60	CD
01	E	31	BCE	61	CDE
02	F	32	BCF	62	CDF
03	EF	33	BCEF	63	CDEF
04	G	34	BDG	64	CDG
05	EG	35	BCEG	65	CDEG
06	FG	36	BCFG	66	CDFG
07	EFG	37	BCEFG	67	CDEFG
10	B	40	D	70	BCD
11	BE	41	DE	71	BCDE
12	BF	42	DF	72	BCDF
13	BEF	43	DEF	73	BCDEF
14	BG	44	DG	74	BCDG
15	BEG	45	DEG	75	BCDEG
16	BFG	46	DFG	76	BCDFG
17	BEFG	47	DEFG	77	BCDEFG
20	C	50	BD		
21	CE	51	BDE		
22	CF	52	BDF		
23	CEF	53	BDEF		
24	CG	54	BDG		
25	CEG	55	BDEG		
26	CFG	56	BDFG		
27	CEFG	57	BDEFG		

TABLE 2. Code Assigment Numbers

1. The pulse rise time from 10% to 90% of maximum voltage amplitude shall be 0.1 μsec or less.

2. The pulse fall time from 90% to 10% of maximum voltage amplitude shall be 0.2 μsec or less.

3. The pulse duration, measured at 50% (6 db) of maximum voltage amplitude, shall be 0.35 to 0.55 μsec.

Observing the ATC Transponder (Airborne Transmitter) Pulses

1. Use the Initial Setup for ATC, except the oscilloscope should be connected to the MONITOR-XMTR connector on the Isolator-Monitor.

2. The Function Switch (1E) should be in the MON/CAL position.

NOTE: A diode detector, as used for monitoring, is a nonlinear device resulting in amplitude distortion. For exacting amplitude measurements, the oscilloscope grid must be calibrated with the particular detector used and at the particular operating levels.

3. Observe the following pulse characteristics:
   a. Pulse rise time
   b. Pulse fall time
   c. Pulse duration

These characteristics should conform to the requirements specified in the ATC Equipment Handbook.

SECTION IV
THEORY OF OPERATION

The Boonton Radio Company Type 8925A Test Set was specifically designed for testing DME (Distance Measuring Equipment), ATC Transponder (Air Traffic Control) and TACAN (Tactical Air Navigation) systems.

The DME system provides the pilot of an aircraft with a continuous digital readout of the aircraft's distance in nautical miles from a given ground station. The system is set in operation by the aircraft transmitter which transmits interrogating pulses to the ground station. The ground station sends an appropriate reply, which can be decoded by the airborne DME receiver to give the required readout. This system has 126 one-mc channels available for use. In all cases the transmitter frequency is 63 mc above or below the receiver frequency for a particular channel.

The ATC system is a ground controlled system for identifying aircraft on a radarscope. The aircraft carries a receiver transmitter which receives the interrogations so the transmitter may return a manually adjusted, coded, reply. All airborne ATC Transmitters operate at 1090 mc and all airborne ATC Receivers at 1030 mc.

The TACAN system was developed for the Military. TACAN is essentially the DME system with the ground station output connected to a special rotating directional antenna. As a result of the antenna rotation, the aircraft receives an amplitude modulated DME reply at the receiver with a directionally oriented pulse. The reply and pulse combination is phase related such that the airborne equipment is able to indicate not only distance in nautical miles, but direction or bearing of the aircraft. The TACAN system frequencies are the same as DME system frequencies.

The 8925A DME/ATC TEST SET is shown in block diagram form in Fig. 9. The basic test signal is generated in the HO1-8614A Signal Generator, which covers the frequency range of 950 to 1250 mc. The generator incorporates automatic leveling of the output RF, which permits tuning over the entire frequency range with no level adjustment required. The attenuator dial is calibrated to read directly the system output into 50 ohms over the range of −10 to −120 dbm. The frequency controls readily permit adjustment to within 50 kc as the frequency is monitored and displayed by the 5245L/5254A Frequency Converter-Counter combination.

The calibrated RF output from the Signal Generator is fed to the HO1-8403A Modulator. This instrument employs electrically controlled PIN diodes mounted in a strip transmission line. Modulation is accomplished by varying the attenuation of the strip. This method of post generation modulation (modulation external to the Signal Generator) is essentially independent of frequency.

The 8925A requires an external source for video signals. The source should provide pulse coded signals which simulate DME/ATC ground emission information as regards to the pulse spacing and pulse shape, repetition rate, and number of pulses. These signals are used to actuate the HO1-8403A modulator.

The Modulator-Signal Generator

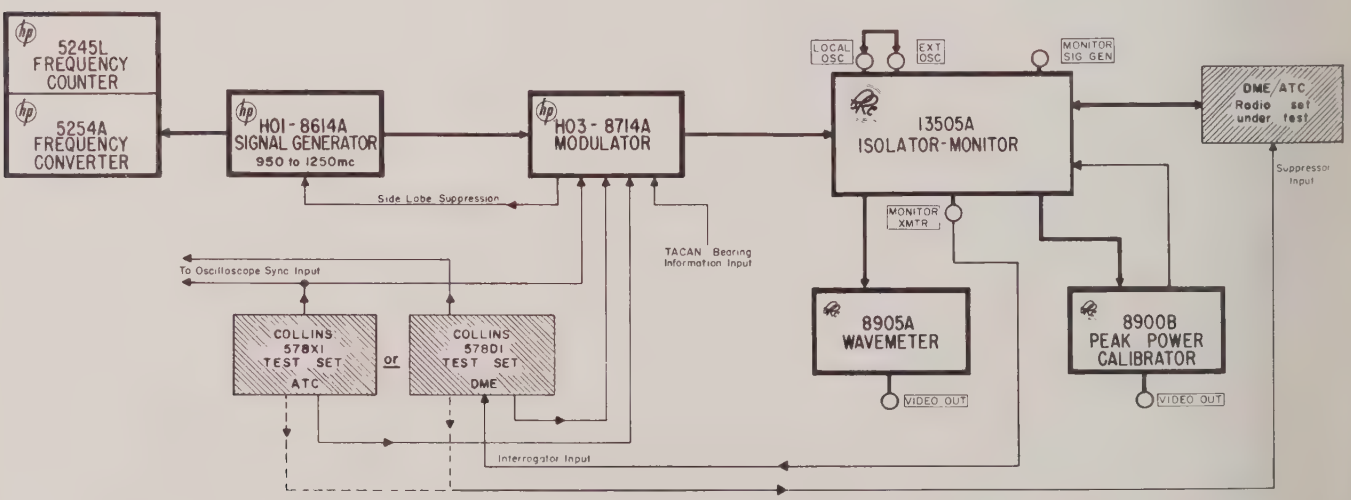
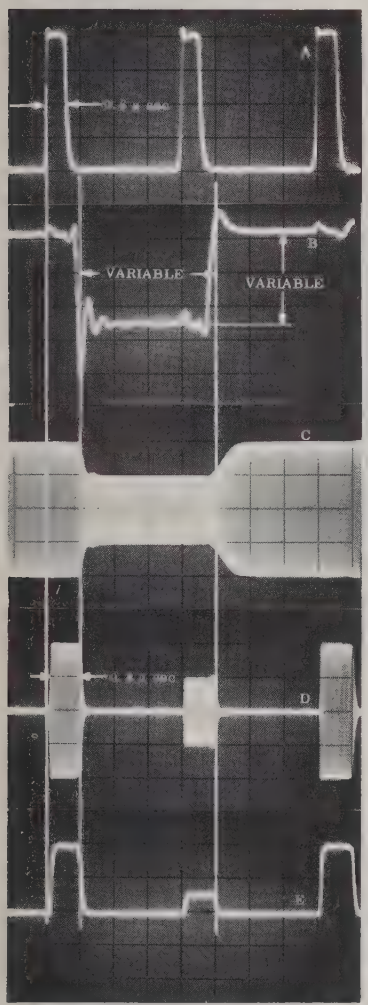


Figure 9. Block Diagram — 8925A

has special provisions for ATC side lobe suppression testing. The Modulator generates a video gate pulse (Fig. 10B), related in time to the second pulse of the video pulse train,



*(A) VIDEO SIGNAL APPLIED TO **HO1-8403A** MODULATOR*

*(B) VIDEO GATE GENERATED BY **HO1-8403A** MODULATOR AND APPLIED TO HO1-8614A SIGNAL GENERATOR*

(C) HO1-8614A SIGNAL GENERATOR RF OUTPUT (VIEWED USING 13505A ISOLATOR-MONITOR HETERODYNE MONITOR)

(D) TEST SET RF OUTPUT (VIEWED USING 13505A HETERODYNE MONITOR)

(E) TEST SET RF OUTPUT (VIEWED USING 13505A DIODE MONITOR)

Figure 10. Generation of the ATC Ground Station Signal

which is adjustable in amplitude, both plus and minus, about a dc reference. This gate pulse is applied to the PIN modulator within the Signal Generator and effectively modulates the Signal Generator output (Fig. 10C) either upward or downward. The amplitude to which the Signal Generator output is modulated by the gate pulse is controlled over the range of +1 to −10 dbm by a calibrated control on the modulator front panel. The Signal Generator rf output then is applied to the Modulator where further modulation takes place (Fig. 10D). The Modulator is turned fully "ON" for the duration of each pulse in the video train. The resulting rf output corresponds to the video pulse train, with the amplitude of the second pulse adjustable relative to the first pulse.

The DME system does not require pulse height variations except as a part of the TACAN system. To simulate a TACAN signal, the DME pulse coded information must be capable of being amplitude modulated up to 55% by a composite signal consisting of 15 and 135 cps sine waves. The low frequency AM represents the rotating directional antenna which provides bearing information to the aircraft.

The various signals from the Signal Generator, Modulator and external equipment provide an input to the 13505A Isolator-Monitor. The 13505A provides a low insertion loss path via the circulator (13505A) to the 8925A output (on the 13505A). This is for the receiver input of the DME, ATC, etc., radio sets under test.

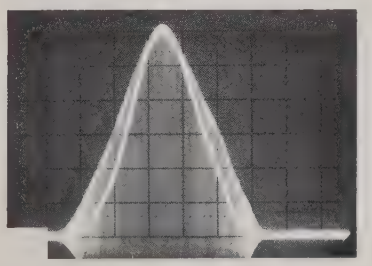


Figure 11. Comparison of Diode Monitor and Heterodyne Displays of the Same RF Signal (Time Axis 1 Microsecond per Centimeter)

The 13505A output (REC/XMTR) is also the transmitter input for the radio sets under test. The (REC/XMTR) radio set connector is isolated by the circulator from the Signal Generator input so high transmitter power does not damage the Signal Generator or Modulator. From the transmitter input back through the 13505A, two attenuated paths are provided. A precisely calibrated path is used to measure transmitter peak power. The other path is terminated by the 8905A Wavemeter which is capable of measuring transmitter frequencies in the vicinity of 1090 mc.

The 13505A allows the Signal Generator - Modulator input to be monitored by an oscilloscope. The pulse coded RF signals can be viewed by use of a diode monitor or heterodyne monitor. Typical comparison of the same pulse, as viewed using the two different monitors, is shown in Fig. 11.

The 8925A, though made up of a series of independent instruments, is completely integrated and calibrated as a system.

For more detailed information, refer to the individual instruction manuals for each instrument.

SECTION V
OPERATIONAL GUIDE

INTRODUCTION

The Operational Guide is a section devoted to the practical application of the 8925A DME/ATC Test Set. This added information should assist in providing more accurate results as the capabilities and limitations of the test set are expanded upon.

TIME DELAY—DME

Distance Measuring Equipment is entirely dependent upon the fact that electrical energy transmitted through space requires a measurable time to travel (186,280 miles per second). Accuracy of the distance measurement is a function of the accuracy of the time measurement. The velocity of the radio waves are in the order of 1000 ft. per μsec (specifically 983.5 ft. per μsec). Therefore, any system time delay will effect the distance accuracy by almost a 1000 feet for each microsecond of delay. If accurately measured, the delay can be taken into account to eliminate this error.

The time delay contributed by the 8925A Test Set can be readily measured using a dual trace oscilloscope (such as an -hp- 175A). The output of the DME video modulator can be compared with the monitored output of the signal generator at the MONITOR - SIG GEN connector. Fig. 12 shows the two signals on the oscilloscope with the time delay of a typical 8925A system. (Refer to the DME Modulator instruction manual for information regarding readjustments to compensate for time delay.)

COUNTING DME/ATC VIDEO PULSES

The 8925A Test Set is designed for use with DME (Collins 578D-1) and ATC (Collins 578X-1) modulators whose outputs are pulses of varied shapes. As shipped from the factory, the -hp- 5245L Electronic Counter will not count these video pulses directly from the DME or ATC modulators, or the Diode Monitor output of the Isolator-Monitor. The input of the counter requires a positive and negative-going signal, both portions of the signal having an amplitude greater than 150 mv peak.

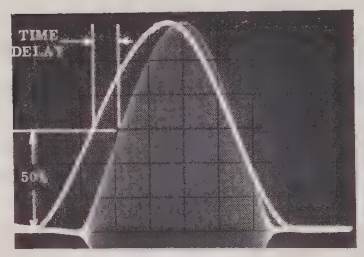


Figure 12.
Typical System Time Delay — DME

The Operating and Service Manual for the -hp- 5245L Electronic Counter gives an explanation for the operation of the counter with a sine wave input. Graphically, the operation is shown in Fig. 13A. With the input voltage increasing in the positive direction from zero volts ac, the signal triggers the input to the counter as it crosses the upper hysteresis limit. The signal level reaches maximum and decreases to zero while passing through the upper hysteresis limit. The negative-going signal has no effect at this time. From zero going in the negative direction, the level crosses the lower hysteresis limit to again trigger the counter input. Each triggering point is crossed once for each cycle to be counted. It should be noted that the sine wave with no external dc reference is symmetrical above and below the internal dc bias, which is centered between the hysteresis limits.

With a positive-going pulse (Fig. 13B) instead of a sine wave, the bias will not allow the pulse to pass through the lower hysteresis limit, thus no count will be shown on the counter. To count positive-going (or negative-going) pulses, one of several methods can be used. However, the recommended method for this application requires no counter adjustments or external bias, but involves distorting the waveshape of the pulse with a simple differentiating network. Fig. 14A shows a DME, Gaussian-shaped, pulse pair from the output of the DME modulator. The hysteresis limits have been added to show why these pulses cannot be counted. Fig. 14B is the result of the pulse pair (Fig. 14A) being passed through the network of Fig. 15. By careful choice of components, either positive-going or negative-going pulses can be read equally well; the choice of components being based upon the repetition rate and shape of the pulses. The network shown (Fig. 15) is adequate for both DME and ATC pulses whether the source be the DME modulator, the ATC modulator, or the video output of the Diode Monitor

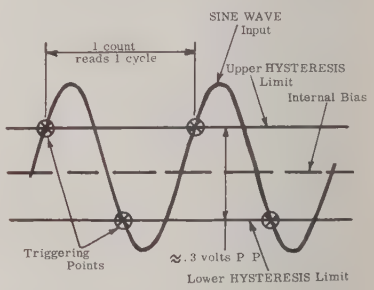


Figure 13A.
Counter Input Using Sine Wave

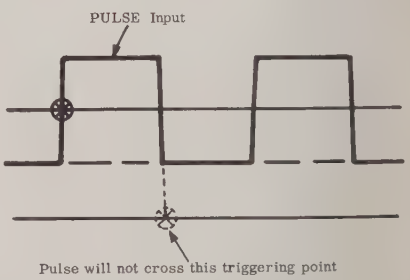


Figure 13B.
Counter Input Using Pulses

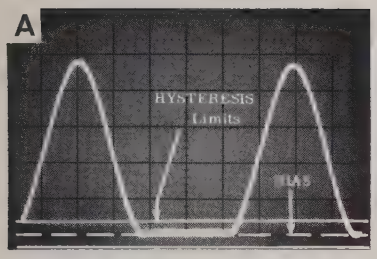


Figure 14A.
Counter Input Using DME Pulses

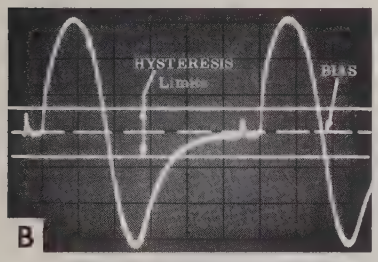


Figure 14B. Counter Input Using Differentiate DME Pulses

from the MONITOR - SIG GEN (13505A).

NOTE: To assure adequate input to the counter, check the input signal with a calibrated oscilloscope.

USING RECTANGULAR-SHAPED DME PULSES

It has been a practice to use rectangular DME pulses for the test and alignment of DME airborne equipment. The Collins 578D-1 DME Bench Test Set, when unmodified, has rectangular pulse output. This signal, when applied to the 8925A DME input will not produce a useable RF output as this input was designed to operate from a Gaussian-shaped DME pulse. To accommodate the rectangular pulses the ATC input must be used as it is designed for pulses of this shape.

To properly utilize the ATC input the following information regarding the basic operation of the input must be understood. The incoming pulses are used to operate two circuits. One circuit turns the RF signal on and off to form the RF pulsed output from the 8925A. The second circuit controls the SLS system used in conjunction with ATC. The circuit controlling the RF is triggered at approximately the 1 volt level. Fig. 16 shows how the video pulse amplitude effects the RF pulse width. In Fig. 16A with a 30 volt video pulse the 1 volt level is well below 10% of maximum pulse amplitude which is out of range of the specified rise and fall time. The width of the pulse at this 1 volt level determines the RF pulse width. With a slow fall time below the 10% level, the pulse width could fall out of the range of the ARINC specifications. Reduction of the pulse amplitude (578D-1—rear panel control - R205) to 8 volts peak will bring the 1 volt level within the range of controlled rise and fall time. In the example shown by Fig. 16B the video pulse and the RF pulse have the same width, which is the ideal condition. It will be noted from Fig. 16 that the pulse amplitude adjustment effects the system time delay which must be taken into account.

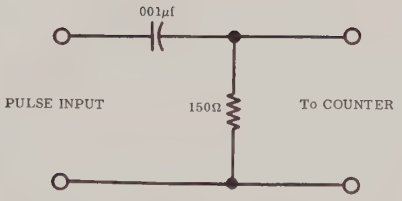


Figure 15. Differentiation Network

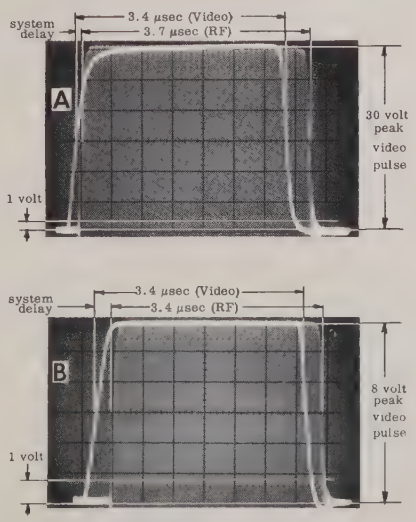


Figure 16. Effect of Video Pulse Amplitude on RF Pulse Width

It has been determined that a video pulse amplitude of 8 volts will properly operate the second circuit for the SLS function. The SLS system must be connected when using the ATC input in order to maintain the proper RF level as read on the attenuator readout. The SLS function is triggered by sync pulses. For DME operation, the sync connection to the 8925A should be omitted to avoid changing the second pulse amplitude by the SLS system. If the sync signal to the 8925A is connected, the SLS control on the 8925A should be set at 0 db.

TYPICAL OUTPUT AMPLITUDE — DRIFT DATA

The System is intended to be turned on and operated in either of the two pulse modes, ATC or DME (includes TACAN). The CW mode is intended for calibrating purposes. An initial warm-up time of two hours is recommended.

When the system is operated during the initial warm-up period in either of the two pulse modes and is switched periodically to the CW mode for measurement purposes, the CW output exhibits a downward drift over the first two hours. The overall change in CW level may be of the order of 2 dbm; typically, 80% of this drift occurring during the first hour.

When operating in the ATC mode, the drift in ATC level will be of the order of 1 dbm over the first two hours of operation; typically, 80% of the total drift occurring during the first half hour.

When operating in the DME (or TACAN) mode, the drift in level may be as much as 6 db in the first two hours of operation; typically, 80% of the total drift occurring during the first hour.

It should be noted, that even though this downward drift in CW level occurs during the two-hour warm-up

period, this does not preclude operation of the instrument during this period because:

1. The CW level can be calibrated at anytime by measuring the system output with an -hp-431B Power Meter and adjusting (as required) the CW LEVEL control on the HO1-8403A.

2. The ATC level can be calibrated at anytime by comparing the Heterodyne Monitor displays of ATC pulses and CW signal and adjusting the ATC LEVEL control on the HO1-8403A until the ATC display is equal in amplitude to the CW display.

3. The DME (or TACAN) level can be calibrated in the same manner as the ATC level, by adjusting the DME LEVEL control on the HO1-8403A.

SECTION VI
MAINTENANCE

GENERAL

The 8925A DME/ATC Test Set is a system made up of separate instruments which have been rack mounted to form a single unit. Maintenance repair, and calibration procedures are covered in the Instruction Manuals for each individual instrument. Material covered in other manuals will not be repeated.

PREVENTATIVE MAINTENANCE

Ventilation

The 8925A utilizes forced-air cooling for all instruments installed in the rack. Operating the instrument with the vents and filter blocked will not only shorten component life, but will require much longer warm-up time for frequency stabilization.

Loose Cables

The 8925A contains RF, video, and power cables on the front panel and in the rear of the instruments. These cables should be checked periodically to assure good contact to the mating plug or receptacle. Rear cables can be checked after opening the door at the rear of the test set.

TROUBLE SHOOTING AND REPAIR

Trouble Shooting Chart

The Trouble Shooting Chart (Fig. 18) shows the test procedures required to isolate troubles to a specific instrument. Location of the specific trouble within an instrument will require reference to the instruction manual for that instrument. As a preliminary procedure to trouble shooting, refer to the Instrument Checkout —Section III Operating Instructions.

MECHANICAL DISASSEMBLY PROCEDURES

Electronic Counter, Signal Generator, Modulator, Isolator-Monitor

The Electronic Counter, Signal Generator, Modulator, or Isolator-Monitor may be individually removed from the rack assembly by disconnecting cables at front and rear panels; then removing the mounting screws at the front panel.

Wavemeter and Peak Power Calibrator

1. These instruments must be removed from the rack assembly as a unit, by disconnecting cables at front and rear panels, then removing the mounting screws securing the rack adapter frame.

2. Either instrument may be removed from the rack adapter frame.

Filter Fan (Fig. 17)

REPLACEMENT

1. Insert block between clips so that the formed guide rails on the clips enter the slots in the block. For air movement in the direction shown, slide the block in until the lugs in the clips snap into the recesses in the block, shown as recess #3. It is necessary to bend the clips slightly away from the block while inserting it so that recess # 1 and the outer wall of recess #3 will not engage the clips prematurely.

2. Insert Filter box and frame assembly between the clips. It is held in place by retaining fingers on the clips.

NOTE: If block must be removed, spring tabs carrying lugs can be pried away from the block with a knife or screw driver inserted along inside edge of clip. Block should then be drawn out, not pushed in.

Lubrication

An oil ejector is required for this procedure.

1. Remove cap from end of oil injector.

2. Place needle at the center of circle marked on the gold label.

3. Position the needle at an angle of approximately 45° to the surface of the label and tangent to the perimeter of the circle.

4. Pierce the label and the concealed self-sealing rubber cap located under the label.

5. Insert the needle approximately 1/4″.

6. Depress the plunger of the oil injector slowly to the next calibration mark which will allow 1/16″ of oil to escape.

NOTE: It is better to give a little more oil than not enough, however, do not overflow the well.

If the ambient temperatures are extremely hot, it may be advisable to oil more frequently to insure the optimum performance characteristics of the fan.

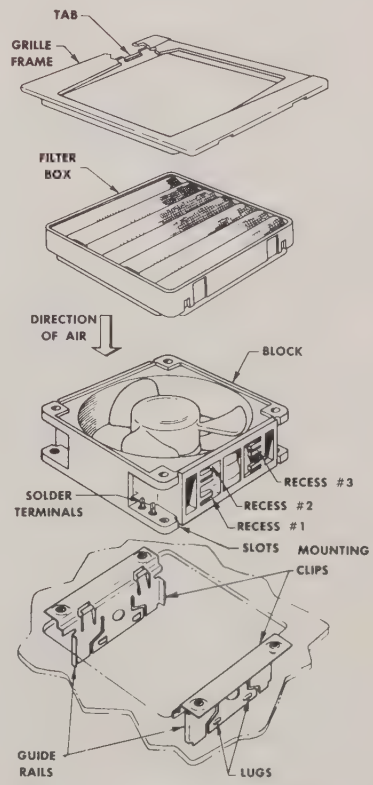


Figure 17. Filter Fan Replacement

SYMPTOM	SUSPECTED INSTRUMENTS	LOCALIZING FAULT
1. No indication on Electronic Counter	a. Electronic Counter	a. Connect cable from Electronic Counter to Monitor-XMTR (13505A). From back of instrument disconnect short cable at EXT OSC (13505A) and connect it to 8900 MON (13505A) after removing original cable. This is a high output source of RF at 1025 ±5 mc (Mon Sel Switch in HET MON position). No indication on counter indicates defective counter.
	b. Signal Generator	b. Check signal generator output using the heterodyne or diode monitor. No response from monitors indicates defect in signal generator.
2. No RF output from 8925A	a. Signal Generator	a. Output from signal generator is shown on Electronic Counter. This is an indication that the signal generator is working properly.
	b. Modulator	b. With an output frequency reading on the Electronic Counter from the Signal Generator, check the Modulator output with a power meter such as an -hp- 431B.
	c. Isolator-Monitor	c. If above two tests show the Signal Generator and Modulator to be working satisfactorily the trouble must be in the Isolator-Monitor.
3. Weak RF output	a. Signal Generator	a. Measure output of Signal Generator at calibrated output connector. Output signal should be approximately 7 db more than indicated on output attenuator readout.
	b. Modulator	b. Measure output of modulator at RF POWER-OUTPUT connector. Output signal should be approximately 5 db less than output from Signal Generator.
	c. Isolator-Monitor	c. If above two tests show the Signal Generator and Modulator to be working satisfactorily the trouble must be in the Isolator-Monitor.
4. No power indication from DME Transmitter	a. Isolator-Monitor	a. Check for frequency indication in the range of the Wavemeter. RF must be pulse modulated for the Wavemeter to respond. If Wavemeter operates, the Isolator-Monitor could be working properly. Also check attenuators to power meter from circulator in Isolator-Monitor.
	b. Peak Power Calibrator	b. Connect cable direct to Signal Generator output from the Peak Power Calibrator. With oscilloscope at VIDEO OUT connector and maximum output from Signal Generator, check for indication on oscilloscope.
5. No power indication from ATC Transmitter	a. Isolator-Monitor	See Localizing Fault 4a and 4b.
	b. Peak Power Calibrator	
	c. Modulator	Note: The ATC transmitter operates only after being interrogated by the ground station (or simulated ground station). No signal from the Signal Generator/Modulator would cause the transmitter not to operate.
	d. Signal Generator	See Symptom 2.
6. No frequency indication from DME Transmitter	a. Isolator-Monitor	a. Check for power indication on Peak Power Calibrator. If Peak Power Calibrator operates, the Isolator-Monitor could be working properly.
	b. Wavemeter	b. Connect the Wavemeter directly to the Signal Generator/Modulator (set to maximum output) and check operation of the Wavemeter. It should be noted that the Wavemeter does not respond to CW so the RF must be pulse modulated, preferably by waveshapes similar to the DME or ATC pulse and having similar duty cycle.

Figure 18. Trouble Shooting Chart

7. No frequency indication from ATC Transmitter	a. Isolator-Monitor	See Symptom 6.
	b. Wavemeter	
	c. Modulator	Note: The ATC transmitter operates only after being interrogated by the ground station (or simulated ground station). No signal from the Signal Generator/Modulator would cause the transmitter not to operate.
	d. Signal Generator	See Symptom 2.
8. Signals on base line between pulses in Monitor Displays	a. Modulator	a. Disconnect modulator from 13505A. If defective, the signals on base line will disappear. See Modulator instruction manual for adjusting PIN diode bias current.
	b. Isolator-Monitor	b. If Modulator is working properly, check 13505A for poor power supply and RF filtering.
9. Apparent inability to modulator DME pulses (for Tacan simulation) to 55%	a. Modulator	a. Check for limiting in Modulator. Symetrical limiting at top and bottom of waveform in oscilloscope display for heterodyne monitor usually indicates trouble in Modulator. (See Modulator instruction book for information on adjusting PIN diode bias.)
	b. Isolator-Monitor	b. Check for limiting in Isolator-Monitor. Limiting at top or bottom only of waveform in oscilloscope display usually indicates trouble in Isolator-Monitor amplifier. (See 13505A instruction book for gain adjustment.)
10. Apparent inability of 2nd pulse to reach +1 db as on oscilloscope display using HET MON (ATC SLS testing).	a. Modulator	a. See Localizing Fault 9a.
	b. Isolator-Monitor	b. See Localizing Fault 9b.

Figure 18. Trouble Shooting Chart (continued)

SYSTEM CALIBRATION PROCEDURE

Any tolerances listed in this section are the limits indicated by the Specifications in Section II. Factory adjustments are made to considerably closer tolerances corresponding to standard practice in the industry. Field adjustments to closer than specified tolerances are possible if time and patience are used.

Recommended Equipment List

The following instruments are recommended for use in the calibration procedure for the 8925A DME/ATC Test Set. Pertinent information is given for substitution purposes.

1. -hp- 175A Oscilloscope with dual trace Plug-in Head

Frequency response (each channel): 40 mc

Vertical amplifier sensitivity: 50 mv/cm

2. -hp- 431B Power Meter

Power measurement range: 1 μw to 10 mw

Accuracy: ± 3% of full scale

3. -hp- 478A Thermistor Mount for use with the -hp- 431B Power Meter

4. -hp- 200AB Audio Oscillator

Frequency: 135 cps

Output: 15v into 600 Ω

5. -hp- 908A 50 Ω Terminations (2 req'd)

6. 150 Ω Load

Can be assembled using a UG-88/U Connector and a 150 Ω, 1 watt, ± 10% carbon resistor.

7. Collins 578D-1 DME Bench Test Set modified for Gaussian pulse output

Provides all the video signals required for the testing and aligning of DME equipment as per ARINC Characteristic 521B.

8. Collins 578X-1 Transponder Test Set

Provides all the video signals required for the testing and aligning of ATC equipment as per ARINC Characteristic 532B.

9. -hp- 489A TWT Amplifier

Frequency Range: 1 to 2 Gc

Gain: 30 db

Output: 1 watt

10. Weinchel 40 db Attenuator with Class A calibration

Accuracy: ± 0.08 db

11. Weinchel 10 db attenuator with Class A calibration

Accuracy: ± 0.02 db

PRELIMINARY SETUP

1. Connect equipment as shown in Fig. 19.

2. Turn on all equipment except the modulator (HO1-8403A).

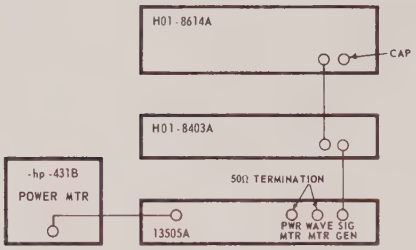


Figure 19.
Setup for Attenuator Adjustment

3. The signal generator should have the ALC and RF pushbuttons depressed and the ALC control set for "O" on DBM meter. The Monitor Selector Switch (13505A) should be in NORMAL position. Adjust the signal generator (HO1-8614A) to 1030 mc with an output of −10 dbm as read on the power meter.

CALIBRATION PROCEDURE

1. Turn on modulator (HO1-8403A). The reading on the power meter should not change. If there is a change, readjust the signal generator (HO1-8614A) output for −10 dbm reading on power meter.

2. Depress CW pushbutton on modulator (HO1-8403A). Adjust modulator CW LEVEL (screwdriver adjustment) control for a reading of −15 dbm on power meter.

3. Readjust signal generator (HO1-8614A) attenuator until the power meter reads −14 dbm.

4. Tune signal generator over the frequency range (960 to 1220 mc) while noting maximum and minimum outputs. The nominal output is halfway between the maximum and minimum output.

5. Tune signal generator (HO1-8614A) to a frequency which has nominal output. Readjust the signal generator output for −14 dbm reading on power meter.

6. The signal generator attenuator (HO1-8614A) should now read −14 dbm. If it doesn't read this amount, readjust the setup using either step *a* or *b* below.

a. If the attenuator reads between −14 and −15 dbm, readjust the attenuator to −14 dbm. Adjust the CW control on the modulator (HO1-8403A) for −14 dbm reading on power meter.

b. If step *a will* not correlate the output reading with the attenuator setting, the output, as read on the power meter, will have to be adjusted to −14 dbm and the attenuator dial will have to be adjusted as follows:

(1) Disconnect cables and disassemble Sig. Gen. from rack allowing access to top cover.

(2) Remove top cover of Sig. Gen.

(3) Loosen two socket head setscrews in bevel gear on attenuator drive shaft without disturbing the attenuator setting. Push gear away from mating gear on attenuator shaft.

(4) Rotate attenuator knob until attenuator reads −14 dbm.

(5) Slide bevel gear on attenuator drive shaft back in place, making sure the setscrews in the loose gear are accessible without disturbing the setting of the attenuator. Tighten setscrews.

(6) Rotate the attenuator knob to assure smooth operation and adjust gear accordingly.

(7) Replace top cover, reinstall instrument in rack, and reconnect cables.

(8) After suitable warmup, adjust the attenuator to −14 dbm. The power meter should read −14 dbm.

7. Connect the equipment as shown in Fig. 20. Set Monitor Selector Switch (13505A) to HET MON. Depress AM (HO1-8614A) pushbutton. Adjust signal generator attenuator to −10 dbm.

8. Tune signal generator (HO1-8614A) to 1025 ± 0.5 mc until a zero beat is observed on the oscilloscope. If beat frequency is out of specified range, readjust the frequency control behind the plugbutton at the rear of the Isolator-Monitor (13505A).

9. Readjust signal generator frequency to 1030 mc (signal generator output at −10 dbm). The CW display should be 1.0v p-p minimum.

NOTE: Less than 1.0v p-p could indicate misadjustment of the gain in the Isolator Monitor amplifier. See R307 Adjustment, 13505A instruction manual.

Adjust oscilloscope for full-scale deflection of display.

10. Depress the ATC (HO1-8403A) pushbutton. A pulse display is shown in Fig. 21. The first pulse should be adjusted for full-scale deflection using the front panel screwdriver adjust-

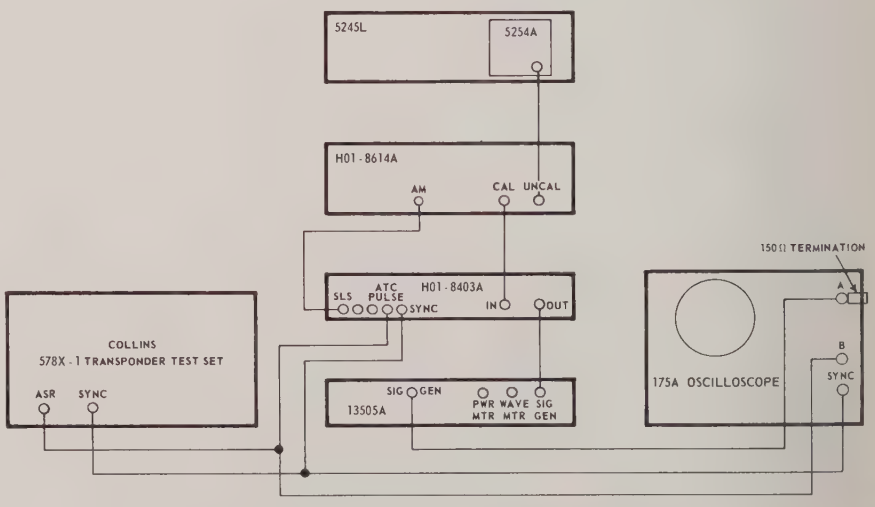


Figure 20. Setup for ATC System Calibration

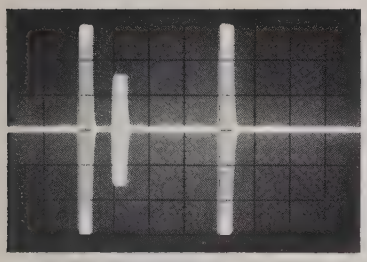


Figure 21.
Oscilloscope Display — ATC Pulse

ment, ATC LEVEL (HO1-8403A).

11. Adjust signal generator (HO1-8614A) attenuator to reduce the pulse output by 25%. Rotate SLS (HO1-8403A) control and observe the second pulse of the display.

> **NOTE:** SLS control will not change the second pulse amplitude unless the sync signal is connected to the sync input (HO1-8403A).

The control should be capable of continuously changing the amplitude of the second pulse from 120% of the first pulse amplitude to 30%, thus assuring the calibrated range of +1 to −10 db.

12. Set the second pulse amplitude at 50% (6 db) of first pulse. Using the SLS position control on the Transponder Test Set, move the second pulse toward the first pulse. The second pulse should be capable of moving to within 0.5 μsec of the trailing edge of the first pulse without affecting the amplitude or shape of the pulses.

13. Increase the oscilloscope gain to observe the base line. There should be no signals on the base line between pulses. (See Trouble Shooting Chart—Symptom 8.)

14. Connect the equipment as shown in Fig. 22. Depress the CW pushbutton (HO1-8403A). Set signal generator attenuator to −10 dbm. The CW display should be 1.0v p-p minimum. Adjust the oscilloscope for full-scale deflection.

15. Depress the DME pushbutton (HO1-8403A). A pulse display is shown in Fig. 23. The first pulse

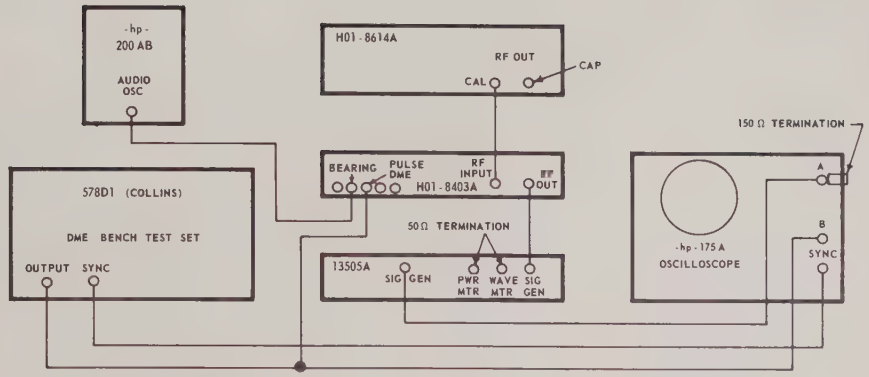


Figure 22. Setup for DME/TACAN System Calibration

should be adjusted for full-scale deflection using the front panel DME LEVEL adjustment (HO1-8403A).

16. The Gaussian shaped pulse of Fig. 23 should meet the requirements of ARINC Characteristic 521B. If this pulse shape is incorrect, refer to the HO1-8403A operating and service manual for instructions.

17. Set audio oscillator to 135 cycles at minimum output. Depress TACAN pushbutton (HO1-8403A). Decrease the oscilloscope display to 50% of full scale by lowering display on screen. Increase the audio oscillator until the pulse amplitude reaches 160% of original value. Fig. 24 shows oscilloscope display. No overloading or "flattening out" should occur in the display. (Refer to Trouble Shooting Chart — Symptom 9 if instrument does not meet this requirement.)

18. Connect the equipment as shown in Fig. 25. Set signal generator (HO1-8614A) frequency to 1030 mc. Adjust signal generator and amplifier output until power meter reads 0 dbm.

19. Disconnect amplifier from the standard 40 db attenuator (without disturbing signal generator/amplifier connection) and connect it to the REC/XMTR connector (13505A). Change the power meter connection to the cable normally attached to the peak power calibrator. Note power meter reading.

20. From power meter readings, determine the difference in attenuation between the standardized 40 db attenuator and the system attenuation between the REC/XMTR connection and the input to the peak power calibrator. Subtract 40 db from the system attenuation.

Example:

Accurately calibrated 40 db pad	= 40.2 db
Difference reading from power meter	= 1.3 db
System attenuation	= 41.5 db
Less 40 db	= 40.0 db
Attenuation Offset	= 1.5 db

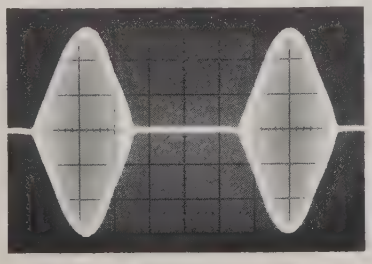


Figure 23.
Oscilloscope Display — DME Pulse

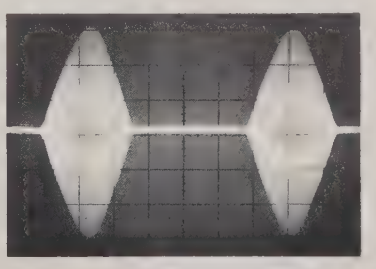


Figure 24. Oscilloscope Display — Simulated TACAN Pulse

This would mean that a 1000 watts at the REC/XMTR input would produce an 84.1 mw (or −1.5 db on peak power calibrator scale) signal at the input to the peak power calibrator.

21. Using the power meter and the calibrated 10 db attenuator, adjust the signal generator for a reading of 10 dbm less the difference reading from Step 20. This difference is the peak power calibrator attenuation offset as recorded on the instrument rear panel.

22. Disconnect the attenuator and power meter from the signal generator/amplifier. The output should be slightly less than 100 mw. Connect this output to the peak power calibrator. The peak power calibrator should indicate 100 mw ± 1.2 db. If the peak power calibrator does not read correctly, refer to the 8900 A/B instruction manual for adjustment procedure.

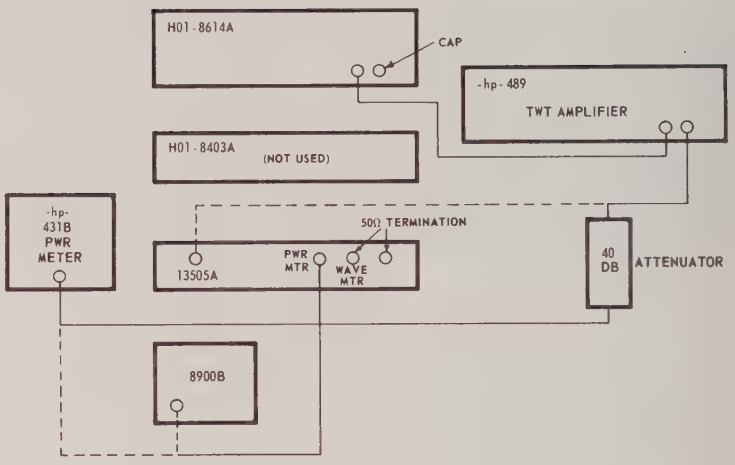


Figure 25. Setup for Peak Power Calibration

23. Using maximum output of the signal generator/modulator and an oscilloscope as the indicator, the wavemeter frequency accuracy can be checked with the electronic counter reading of the signal generator frequency. For gain adjustment of the wavemeter, refer to the 8905A instruction manual.

NOTE: RF signal to wavemeter must be pulse modulated or wavemeter will not respond.

SECTION VII
REPLACEMENT PARTS

GENERAL

A Table of Replaceable Parts for the 8925A is included in this section. Cabinet parts only are included in this table. Replacement parts for the individual instruments in the system are included in the instruction manuals for these instruments.

When ordering replacement parts, specify the BRC part number and the description in the replacement parts table.

See Section VI — Maintenance for detailed disassembly and assembly procedures.

For convenience in obtaining replacement parts locally, a List of Manufacturers is given below. This list is keyed into the Table of Replaceable Parts where the manufacturer's type numbers are also given. When a manufacturer's code and type number are not given, the part is a special part manufactured by or for BRC.

LIST OF MANUFACTURERS

Code	Manufacturer's Name
01121	Allen-Bradley Co.
79405	Wood Electric Corp.
82877	Rotron Mfg. Co.
83315	Harvey Hubbel, Inc.
91737	Gremar Mfg. Co., Inc.
WEI	Waber Electronics, Inc.

TABLE OF REPLACEABLE PARTS

BRC. PART NO.	DESCRIPTION	QTY. PER UNIT	MFG. CODE	MFG'S. PART NO.
0360-0455	Terminal Block	1		
0686-3335	Resistor, Fixed: 33K ohms, ±5%, ½W	1	01121	EB3335
0950-0115	Outlet Box	1	WEI	Model 17
1250-0072	Connector, RF: Series BNC, Type UG-274B/U Adapter, Tee	1	91737	UF274B/U
1251-0315	Connector, Receptacle: Male, 3-wire, polarized	1	83315	7556G
1450-0048	Light, Indicator	1		
2680-0028	Screw, Machine: Cup Washer Head, 10-32 x ½", Phillips Drive, Steel, Nickel Plate	22		
3103-0033	Switch, Slide	1		
3105-0007	Circuit Breaker	1	79405	112-210-101
3150-0036	Filter Assembly, Air (Includes 3160-0049 Mounting Clips)	2	82877	15449
3160-0026	Fan, Tube Axial	2		
3160-0049	Mounting Clips (Fan Assembly)	2	82877	13996
08925-60001	Cable Assembly: Brown	1		
08925-60002	Cable Assembly: Red	1		
08925-60003	Cable Assembly: Purple	1		
08925-60004	Cable Assembly: Blue	1		
08925-60005	Cable Assembly: Green	1		
08925-60006	Cable Assembly: Yellow	1		
08925-60007	Cable Assembly	1		

BRC. PART NO.	DESCRIPTION	QTY. PER UNIT	MFG. CODE	MFG'S. PART NO.
08925-60008	Cable Assembly: Orange	1		
08925-60009	Cable Assembly: Gray	1		
08925-60010	Cable Assembly: Maroon	1		
08925-60011	Cable Assembly: Pink	1		
08925-60012	Cable Assembly: White	1		
08925-60013	Cable Assembly: Tan	1		
08925-60016	Load Assembly: 150 ohm	1		
08925-60017	Power Cord and Plug Assembly	1		

MP MASTER
MA25152